

Application No.: 09/870957
Group Art Unit: 1746

Docket No.: IIW-003

AMENDMENTS TO THE CLAIMS

In the Claims

Please amend claims 1, 13, 24, 25, 34, 40 and 42 and cancel claims 14, 21, 23, 26, 31, 38 and 41 as follow.

1. (Currently Amended) An apparatus for warming-up a fuel cell, wherein a supply gas is supplied into the fuel cell and discharged as an exhaust gas after being utilized by the fuel cell, the apparatus comprising:

means for returning an exhaust gas to the supply gas depending upon a warming-up condition at a time of starting up the fuel cell, and when the temperature of the fuel cell is lower than a prescribed level; and

a heat exchanger which conducts heat-exchange between the supply gas and the exhaust gas.

2. (Previously Presented) The apparatus for warming-up a fuel cell as claimed in Claim 1, further comprising:

a controller for controlling said means for returning the exhaust gas when the temperature of the fuel gas is lower than a prescribed temperature.

3-10. (Canceled)

11. (Previously Presented) The apparatus for warming-up a fuel cell as claimed in Claim 1, wherein said supply gas is air which is supplied to an oxygen pole side of the fuel cell, and further comprising a controller for controlling said means for returning the exhaust gas depending upon the amount of oxygen in the air supplied into the oxygen pole of the fuel cell.

12. (Previously Presented) The apparatus for warming-up a fuel cell as claimed in Claim 11, wherein the means for returning the exhaust gas decreases the amount of

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exhaust gas to be returned when the amount of oxygen is decreased due to the power generation of the fuel cell.

13. (Currently Amended) An apparatus for warming-up a fuel cell which supplies a supply gas into the fuel cell and which discharges the supply gas as an exhaust gas after being utilized in fuel cell, said apparatus comprising:

a compressor for compressing the exhaust gas to generate heat by adiabatic compression and supplying the exhaust gas to the supply gas,

wherein the supply gas is heated by the exhaust gas, the heated supply gas is supplied into the fuel cell to warm the fuel cell, and all of the exhaust gas discharged from the fuel cell is returned to the compressor to form a circulation cycle during a warming-up period at a time of starting up the fuel cell and when the temperature of the fuel cell is lower than a prescribed level, wherein said circulation cycle includes a heat exchanger which conducts heat-exchange between the supply gas drawn by the compressor in a negative pressure and the exhaust gas adiabatically heated by said compressor.

14. (Canceled)

15. (Previously Presented) The apparatus for warming-up a fuel cell as claimed in Claim 13, further comprising a controller for determining whether or not the warming-up of the fuel cell has been completed, wherein the power generation of said fuel cell is started after the warming-up is determined to be completed.

16. (Canceled)

17. (Previously Presented) The apparatus for warming-up a fuel cell as claimed in Claim 15, wherein the controller determines completion of the warming-up based on the temperature of the exhaust gas discharged from the fuel cell.

18. (Canceled)

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19. (Original) The apparatus for warming-up a fuel cell as claimed in Claim 13, wherein said supply gas is air which is supplied to an oxygen pole side of the fuel cell, when the amount of oxygen in said circulation cycle is decreased due to the power generation of the fuel cell, the fresh air is taken to replenish oxygen.

20-21. (Canceled)

22. (Previously Presented) The apparatus of claim 1, further comprising a humidifier for humidifying the supply gas.

23. (Canceled)

24. (Currently Amended) The apparatus of claim ~~23~~ 1, wherein the means for returning an exhaust gas stops returning the exhaust gas to the supply gas when the temperature exceeds the predetermined level.

25. (Currently Amended) The apparatus of claim ~~23~~ 1, wherein the means for returning an exhaust gas returns all of the exhaust gas to the supply gas when the temperature of the fuel cell is below a predetermined level.

26-33. (Canceled)

34. (Currently Amended) A method for warming-up a fuel cell, comprising the steps of:

supplying a supply gas to a cathode of a fuel cell, wherein the fuel cell reacts the supply gas to produce an exhaust gas;

compressing the exhaust gas to increase the temperature of the exhaust gas,

measuring the temperature of the compressed exhaust gas,

returning the exhaust gas to the supply gas when the temperature of the exhaust gas is lower than a predetermined level; and

increasing an opening in a pressure control valve if the temperature of the compressed exhaust gas exceeds a predetermined level.

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35. (Previously Presented) The method of claim 34, further comprising the step of:

generating an alarm if compressed exhaust gas continues to exceed predetermined level after a predetermined time period.

36-38. (Canceled)

39. (Previously Presented) An apparatus for warming-up a fuel cell, wherein a supply gas is supplied into the fuel cell and discharged as an exhaust gas after being utilized by the fuel cell, the apparatus comprising:

means for measuring the temperature of the exhaust gas;

a compressor, which discharges the exhaust gas from the fuel cell and which returns the exhaust gas to the supply gas, wherein said compressor returns the exhaust gas to the supply gas when the temperature of the exhaust gas detected by said means for measuring the temperature of the exhaust gas is lower than a predetermined level, and wherein said compressor compresses the exhaust gas to increase the temperature of the exhaust gas;

means for measuring the temperature of the compressed exhaust gas; and

a pressure control valve which controls the pressure of the exhaust gas having being compressed by the compressor, wherein an opening in said pressure control valve is increased if the temperature of the compressed exhaust gas exceeds predetermined level.

40. (Currently Amended) An apparatus for warming-up a fuel cell which supplies a supply gas into the fuel cell by a negative pressure suction by a compressor provided on a downstream of the fuel cell, and which discharges the supply gas in an exhaust gas after being utilized in the fuel cell, as an exhaust gas, having being compressed by said compressor, comprising

means for returning an exhaust gas, which has been heated by adiabatic compression through said compressor, wherein said means for returning an exhaust gas returns the exhaust gas at the time of starting up the fuel cell and also the temperature of the fuel cell is lower than a predetermined level, and

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a heat exchanger which conducts exchange between the supply gas drawn by the compressor in a negative pressure and the exhaust gas adiabatically heated by said compressor.

41. (Canceled)

42. (Currently Amended) The apparatus as claimed in Claim 41 ~~40~~, further comprising a valve, which enhance the temperature of the exhaust gas when it is actuated towards the closing direction, provided downstream of the heat exchanger, to enhance the temperature of the exhaust gas introduced into the heat exchanger.

43. (Previously Presented) The apparatus as claimed in Claim 40, wherein the means for returning an exhaust gas returns all of the exhaust gas to the supply gas when the temperature of the fuel cell is below a predetermined level.